



# City of Houston Energy Code Guideline

February 21, 2003 (Revised)

**Scope:** This guideline is to help the Houston building industry to better understand the requirements set forth in the 2000 International Energy Conservation Code (IECC) and the 2000 International Residential Code (IRC) Chapter 11. The 2001 Supplement to the IECC was also adopted as part of the code and is now available on our website to view or download:

[http://www.ci.houston.tx.us/departme/planning/planning\\_dev\\_web/code\\_enf/cd\\_updates.htm](http://www.ci.houston.tx.us/departme/planning/planning_dev_web/code_enf/cd_updates.htm)

**Purpose of the Energy Code:** The Energy Code is mandated by state law in an effort to reduce the air pollutant emissions, moderate future peak electric power demand, and to help control energy costs.

**Overview:** The IECC specifies thermal envelope requirements for new construction, and additions and alterations to existing buildings. The Energy Code primarily focuses on the following requirements:

- Building Envelope; insulation R-values, densities, and thickness
- Window & Door area, Solar Heat Gain Coefficients, and U-Factors
- Heating and Cooling System Efficiency
- Duct Insulation
- Electrical Lighting Loads

## The IECC Structure Is As Follows:

### **Ch. 1 Administration and Enforcement:**

Includes the glazing default tables, some insulation requirements, and defines exempt buildings.

### **Ch. 2 Definitions:**

Defines the terms used throughout the code.

### **Ch. 3 Design Conditions:**

Sets forth climate and zone conditions that are to be used throughout the code.

### **Ch. 4 Residential Building Design by Systems Analysis and Design or Buildings Utilizing Renewable Sources:**

Requires an annual energy analysis. Also known as the performance approach. It is the total energy analysis including all of the buildings systems. (Software utilized.)

### **Ch. 5 Residential Component**

#### **Performance Approach:**

Includes various methods of compliance for the building envelope. Includes Mechanical, Electrical and Plumbing provisions.

### **Ch. 6 Simplified Prescriptive**

**Requirements for Residential Buildings, Type A-1 & A-2:** Sets forth one limited method for residential buildings. (same as Ch. 11 of the IRC)

### **Ch.7 Design of Commercial Buildings:**

Requirements for commercial buildings based on standard ASHRAE 90.1 other than those constructed in accordance with Chapter 8.

**Ch. 8 Acceptable Design Practice for Commercial Buildings:** Prescriptive and Systems Analysis approaches listed.



## New Terms:

Some of the following terms are used throughout the IECC and throughout this document:

1. **Building Envelope.** All the components of a building that enclose conditioned space including walls, ceilings or roofs, and floors, separating it from unconditioned space.
2. **Conditioned space.** Any area where mechanical heating and/or cooling is directly or indirectly supplied.
3. **Energy Performance Testing Program.** Program approved by Texas A&M Energy Systems Lab as providing inspections equivalent to IECC. An ordinance is needed to allow using these programs.
4. **Fenestration.** Skylights, roof windows, vertical windows (whether fixed or moveable), opaque doors, glazed doors, glass block, and combination opaque/glazed doors.
5. **R-value.** A measure of the resistance of a material or assembly to heat transfer. It is the inverse of the U-factor ( $R = 1/U$ ). A high-R-value wall has a greater resistance to heat flow and a higher insulating value than one with a low R-value.
6. **Seasonal Energy Efficiency Ratio (SEER).** The total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/h, divided by the total electric energy input during the same period, in watt-hours, as determined by DOE.
7. **Solar heat gain coefficient (SHGC).** The fraction of solar radiation admitted through a window or skylight, both directly transmitted, and absorbed and subsequently released inward. The solar heat gain coefficient has replaced the shading coefficient as the standard indicator of a window's shading ability. It is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits, and the greater its shading ability. SHGC can be expressed in terms of the glass alone or can refer to the entire window assembly.
8. **U-factor.** A measure of the rate of non-solar heat loss or gain through a material or assembly. The U-factor may be expressed for the glass alone or the entire window, which includes the effect of the frame and the spacer materials. The lower the U-factor, the greater a window's resistance to heat flow and the better its insulating value. The entire building envelope can also be converted to an overall U-Factor.
9. **Residential Building, Type A-1.** Detached one and two family dwelling.
10. **Residential Building, Type A-2.** A building containing multiple (i.e. three or more) dwelling units where the occupants are primarily permanent in nature, such as townhouses, row houses, apartment houses, convents, monasteries, rectories, fraternities, and sororities, dormitories, and rooming houses, all of which are three stories or less in height above grade.

## Buildings Required To Comply:

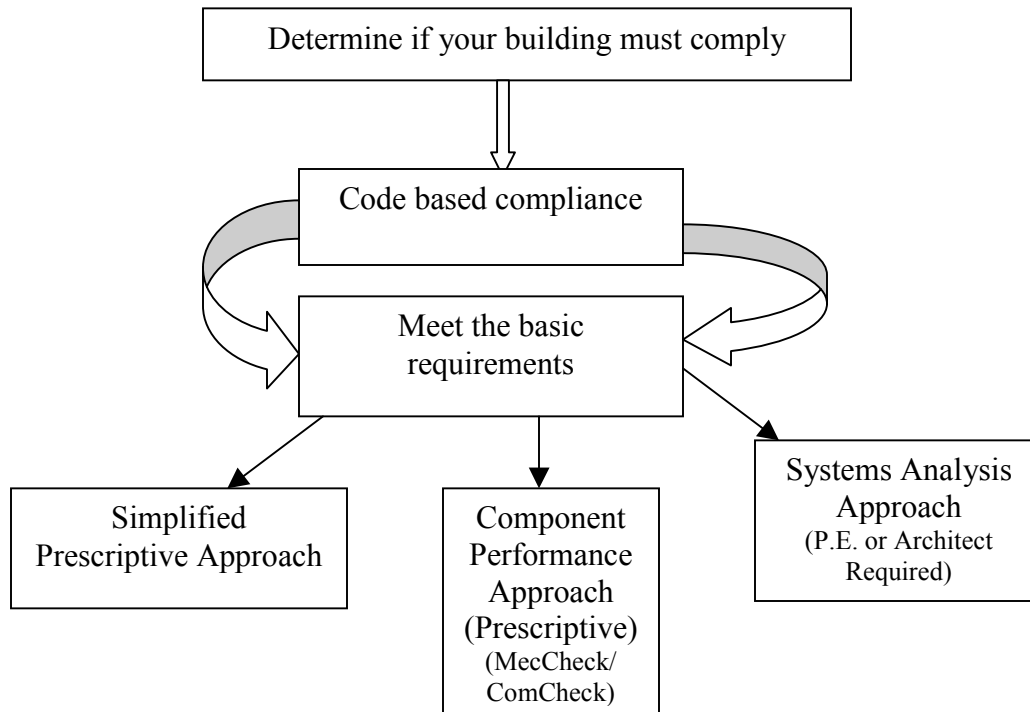
All new buildings and alterations and additions\* to existing buildings must comply with the energy code, with the exceptions noted below:

- existing buildings
- very low energy buildings ( $<3.4\text{Btu/h ft}^2$  or  $1\text{ W/ft}^2$  of floor area)
- buildings that are neither heated nor cooled; or portions of buildings that are separated by a building envelope.
- buildings designated as historical

\*Compliance for residential additions under 500 square feet of conditioned space may be achieved with the prescriptive envelope requirements listed in Table 502.2.5 of the 2000 IECC. To use this alternative prescriptive approach, the total area of windows, doors, and skylights cannot exceed 40 percent of the gross wall and roof area of the addition.

## Paths To Compliance:

The energy code specifies a few basic requirements that are mandatory for all single-family residential construction and then provides a choice of approaches for meeting more detailed envelope requirements. Paths to compliance are diagrammed and discussed below:



- Simplified prescriptive approach follows the simplified prescriptive requirements set forth in Chapter 11 of the IRC, which corresponds with Chapter 6 of the IECC.
- Component Performance Approach allows varying insulation levels, glazing and door areas, and glazing and door U-values. (See Chapter 5 or Chapter 8, sections 801 through 805 of the IECC) In this approach builders/designers may choose to utilize a software program such as ResCheck or ComCheck.
- System Analysis Approach (P. E. Required) allows compliance to be demonstrated by an analysis of the proposed building's annual energy usage. The building is considered to be in compliance if the calculated energy consumption is not greater than a "standard design" meeting the minimum performance requirements of the code. Generally, this comparison uses engineering calculations or a computer simulation. (See Chapter 4 or Chapter 8, section 806 of the IECC)

### Energy Code Compliance Software:

Residential – (Prescriptive) ResCheck – formerly called MecCheck, or RemRate  
(Systems) RemRate, Blast or RemDesign

Commercial – (Prescriptive) ComCheck EZ or ComCheck Plus  
(Systems) DOE2, Blast, Energy Plus, HAP or Trace.



## Basic Code Provisions

*\*\* The Sections numbers and tables indicated are references from the IECC\*\**

**Know your design criteria:**

**Table 302.1**

Exterior Design Conditions	
Condition	Value
Winter, Design Dry Bulb	28
Summer, Design Dry Bulb	96
Summer, Design Wet Bulb	80
Degree Days Heating (HDD)	1371
Degree Days Cooling	3058
Climate Zone	3b

**Prescriptive table values for standard residential construction.** Simplified table may be used without using software or systems analysis engineering.

### Prescriptive Building Envelope Requirements, Type A-1 Residential Buildings, Based On Window Area As A Percent Of Gross Exterior Wall Area For Houston

% Glazing	Maximum	Minimum					
	Glazing U-factor	Ceiling R-value	Exterior wall R-value	Floor R-value	Basement wall R-value	Slab perimeter R-value and depth	Crawl space R-value
8	Any	R-19	R-11	R-11	R-0	R-0	R-5
12	0.75	R-19	R-11	R-11	R-0	R-0	R-5
15	0.75	R-19	R-11	R-11	R-0	R-0	R-5
18	0.70	R-26	R-13	R-11	R-0	R-0	R-5
20	0.70	R-30	R-13	R-11	R-0	R-0	R-5
25	0.55	R-30	R-13	R-11	R-0	R-0	R-6

**Energy Code Compliance Form:** One of the Energy Code Compliance forms shall be submitted with projects that require plans.



### Additional Energy Information on Plans

With the adoption of the energy code, additional information needs to be included on plans to verify compliance. This additional information includes:

- ❑ Completed Energy Analysis Form
- ❑ If a software package is used the output pages from the program
- ❑ Actual proposed R-values and U-factors (not the weighted average R-values and U-factors)
- ❑ A window schedule listing the window locations, sizes, shading devices, U-factors and SHGC for windows, skylights and doors)
- ❑ Type and R-values of insulation to be used with framing details
- ❑ HVAC equipment size and ratings
- ❑ Additional lighting loads
- ❑ Recessed light IC rating requirement

**SHGC requirements\* (§502.1.5):** The area-weighted average SHGC of all glazing cannot exceed 0.4 for residential, or for commercial buildings (§T802.3.2) cannot exceed the value listed in the table. Each commercial table will vary depending on glazing area and projection factors.

The area-weighted average SHGC may be determined in the following way. For each window, multiply the SHGC by the area of the window. Sum together all of the values. Divide the sum by the total window area of the structure:

$$\text{Area-weighted SHGC} = \frac{[(\text{window}_1 \text{ SHGC}) \times (\text{window}_1 \text{ area})] + [(\text{window}_2 \text{ SHGC}) \times (\text{window}_2 \text{ area})] + \dots}{(\text{total window area})}$$

Solar window screens may be used to meet SHGC requirements. The overall SHGC for a window with a solar window screen may be determined with the following equation:

$$\text{Overall SHGC} = [(\text{window SHGC}) \times (\text{solar screen SHGC}) \times (\text{percent area covered})] + [(\text{window SHGC}) \times (\text{percent area not covered})]$$

**NOTE:** Currently there is no SHGC value for glass block. If utilizing glass block (or any other fenestration product without a specified SHGC), use the default values provided in Table 102.5.2(3). Also, Section 602.3 exempts 1 percent of glazing from the SHGC requirement. If you use this exemption, the above equation should be modified appropriately.



## STRUCTURAL

- ✓ **Providing the information (§102.1, 102.2, 102.5.1, and 104.2):** Materials and equipment must be identified so that compliance can be determined. Items such as insulation R-values, glazing and door U-factors and SHGC values, and equipment efficiency shall be indicated clearly on the plans and material or equipment.
- ✓ **Penetrations (§502.1.4):** All joints and penetrations in the building envelope must be caulked, gasketed, weather-stripped, or otherwise sealed.
- ✓ **Insulation requirements (§102.5.1, 102.5.1.1):** For blow-in or sprayed insulation a signed and dated certificate from the insulation installer must be provided listing the initial installed thickness, the settled thickness, the coverage area and the number of bags installed. Thickness markers with 1" letter required every 300 square feet.
- ✓ **Inspections:** In addition to the standard series of inspections a separate insulation inspection must be scheduled and approved. Call after the framing inspection has been approved, but before the drywall is installed to conceal wall, ceiling or floor cavities of the building envelope. This requires that elevated floors will have a subfloor insulation inspection.

## MECHANICAL

- ✓ **Temperature Controls (§503.3.2):** Thermostats are required for each separate HVAC system installed. Exterior thermal controls may be required on heat pump systems.
- ✓ **HVAC Piping Insulation (§503.3.3.1):** Piping shall be provided with insulation in accordance with Table 503.3.3.1 (below).

**TABLE 503.3.3.1  
MINIMUM PIPE INSULATION  
(thickness in inches)**

Piping System Types	Fluid Temp. Range °F	Pipe Sizes <sup>a,c</sup>					
		Runouts up to 2” <sup>b</sup>	1” and less	1.25” to 2”	2.5” to 4”	5” to 6”	8” and larger
Heating Systems							
Steam and Hot Water:							
High pressure/temperature	306-450	1 ½	2 ½	2 ½	3	3 ½	3 ½
Medium pressure/temperature	251-305	1 ½	2	2 ½	2 ½	3	3
Low pressure/temperature	201-250	1	1 ½	1 ½	2	2	2
Low temperature	106-200	½	1	1	1 ½	1 ½	1 ½
Steam and Condensate (for feed water)	Any	1	1	1 ½	2	2	2
Cooling Systems							
Chilled water, refrigerant and brine:	40-55	½	½	¾	1	1	1
	Below 40	1	1	1 ½	1 ½	1 ½	1 ½

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, °C = [(°F)-32]/1.8.

a. For piping exposed to outdoor air, increase insulation thickness by 0.5 inch.

b. Runouts not exceeding 12 feet in length to individual terminal units.



c. Inside pipe diameter.

- ✓ **Duct Installation (§503.3.3.3):** Supply and return ducts for heating and cooling systems located in unconditioned spaces must be insulated to R-6. Ducts outside the building must be insulated to R-8.
- ✓ **Duct Construction and Sealing (§503.3.3.4.2 and 503.3.3.7):** Ducts shall be supported every 10' or in accordance with the manufacturer's instructions. All joints, seams, and connections must be securely fastened with welds, gaskets, mastics, tapes, or other approved material. Mastics and tapes must be UL 181 listed. The HVAC system shall also provide means for balancing air and water systems as well as having air filters in the return air system.

## ELECTRICAL


- ✓ **Recessed lighting fixtures (§502.1.3):** Recessed lighting fixtures shall be type IC rated, manufactured with no penetrations between the inside of the recessed fixture and the ceiling cavity and sealed to prevent air leakage, or shall be installed in a sealed box maintaining the required clearances of not less than 1" from combustible material and not less than 3" from insulation material.
- ✓ **Caulking and sealants (§502.1.4.2).** Exterior joints, seams or penetrations in the building envelope that are sources of air leakage, shall be sealed with durable caulking materials, closed gasketing systems, taped or covered with moisture vapor permeable house wrap. This includes sealing around recessed lights and all electrical penetrations.
- ✓ **Time Clocks. (§504.4)** All pools shall have time clocks installed to allow the pumps to run in off peak electrical demand periods and can be set to maintain the water clear and sanitary.
- ✓ **Electrical energy consumption. (§505.1)** In Type A-2 residential buildings having individuals dwelling units, provisions shall be made to determine the electrical energy consumption consumed by each tenant by separately metering individual dwelling units.
- ✓ **Lighting Power Budget (§505.2).** The lighting systems shall meet the applicable requirements of §805, except Type A-1 residential buildings and the dwelling portions of Type A-2 residential buildings.
- ✓ **Interior lighting controls (§805.2.1).** Except for those areas lighted for security, emergency, or as a path for means of egress, each area enclosed by walls or floor to ceiling partitions shall have at least one manual control for the lighting serving that area.
- ✓ **Bi-level switching (§805.2.1.1).** Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern at least 50 percent, except in areas with on 1 luminaire, controlled by an occupant sensing device, corridors, storerooms, restrooms, or public lobbies or in guest rooms.





- ✓ **Guest rooms (§805.2.1.2).** Hotels, motels, boarding houses or similar buildings shall have 1 master switch at the main entry, that controls all *lighting* fixtures and *switched* receptacles except in bathrooms.
- ✓ **Tandem wiring (§805.3).** One or three lamp fluorescent fixtures within 10 feet of each other shall be tandem wired. Electronic high frequency ballasts and luminaries not on the same switch control or in the same area are not required to be tandem wired.
- ✓ **Total connected interior lighting power (§805.4.1).** The total connected interior lighting power (watts) shall be the sum of the watts of all interior equipment as determined according to Section 805.4.1.1 through 805.4.1.4. Exception: The connected power associated with the following lighting equipment is not included in calculating the total connected lighting power.
  - 1. Specialized medical, dental, and research lighting.
  - 2. Professional sports arena playing field lighting.
  - 3. Display lighting for exhibits in galleries, museums, and monuments.
  - 4. Guest room lighting in hotels, motels, boarding houses, or similar buildings.
  - 5. Emergency lighting automatically off during normal building operation.
- ✓ **Screw lamp holders (§805.4.1.1).** The wattage shall be the maximum labeled wattage of the luminaire.
- ✓ **Low voltage lighting (§805.4.1.2).** The wattage shall be the specified wattage of the transformer supplying the system.
- ✓ **Other luminaries (§805.4.1.3).** The wattage of all other lighting equipment shall be the wattage of the lighting equipment verified through data furnished by the manufacturer or other approved source.
- ✓ **Line voltage lighting track and plug in busway (§805.4.1.4).** The wattage shall be the greater of the wattage of luminaries determined according to Section 805.1.4.1.1 through 805.4.1.3 or 30 watts per linear foot.
- ✓ **Entire building method. (§805.4.2)** The interior lighting power shall be calculated using Section 805.4.2.1 or 805.4.2.2 as applicable.
- ✓ **Entire building method (§805.4.2.1).** Under this approach, the interior lighting power (watts) is the value from Table 805.4.2 for the building type times the conditioned floor area of the entire building.
- ✓ **Tenant area or portion of building method (§805.4.2.2).** The total interior lighting power (watts) is the sum of all the interior lighting power for all of areas in the building covered in this permit. The interior lighting power is the conditioned floor area for each area type listed in Table 805.4.2 times the value from Table 805.4.2 for that area. For the purposes of this method an “area” shall be defined as all contiguous spaces which accommodate or are associated with a single area type as listed in Table 805.4.2. When this method is used to





calculate the total interior lighting power for an entire building, each area type shall be treated as a separate area.

## PLUMBING

- ✓ **Swimming Pools (§504.3.2):** All heated swimming pools must have an on/off pool heater switch. Heated pools require a pool cover unless 20 percent or more of the heating energy (computed over an operating season) is from non-depletable sources. All swimming pool pumps must be equipped with a time clock. Typically, pools with heaters intended to heat the spa feature only on a spa/pool combo do not require pool covers.
- ✓ **Circulating Hot Water (§504.4 and 504.5):** Circulating hot water systems must have automatic or manual controls and pipes must be insulated.
- ✓ **Other Plumbing requirements are:**
  1. Energy efficient water heaters.
  2. Heat traps on water heaters.
  3. Insulate hot water circulating systems.
  4. Water heating equipment shall be provided with controls to allow a set point of 110°F for dwelling units and 90°F for other occupancies.
  5. Not hot water piped to ice makers/refrigerators.
  6. Insulate the first 8' of pipe on noncirculating commercial water heaters.
  7. Seal all plumbing penetrations in the building envelope.
  8. New buildings are considered to be “Unusually Tight Construction” requiring combustion air for water heaters to come from outside of the building.



## Other Energy Code Resources

### **City of Houston**

Code Enforcement Division  
Houston, TX 77002  
Lisa Fleming 713-535-7856  
[www.houstonplanning.com](http://www.houstonplanning.com).

### **State Energy Conservation Office**

<http://seco.cpa.state.tx.us/>

### **Department of Energy**

<http://www.energycodes.gov/>  
<http://www.energystar.gov>

### **Texas A&M Energy Lab**

phone:877-AnM-CODE  
<http://eslsb5.tamu.edu>

### **Efficient Windows**

<http://efficientwindows.org/>

### **Insulation**

<http://insulate.org/>

### **National Fenestration**

### **Rating Council**

<http://efficientwindows.org/>



## NOTES

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